Application of the optimization technique to non-crystalline X-ray diffraction microscopy --- Guided Hybrid Input-Output method (GHIO)

Chien-Chun Chen,[1] Jianwei Miao,[2] Chung-Wei Wang,[3] and **Ting-Kuo Lee**[1]

[1]Institute of Physics, Academia Sinica, Nankang, Taipei, 11529, Taiwan

[2]Department of Physics and Astronomy and California NanoSystems Institute, University of California, Los Angeles, CA 90095, USA

[3]Department of Physics, University of Florida, Gainesville, USA

We have developed a new algorithm that combines the concept of optimization with the conventional hybrid input-output (HIO) algorithm for phase retrieval of oversampled diffraction intensities. In particular, the optimization algorithm of guiding searching direction to locate the global minimum has been implemented. Compared with HIO, this guided HIO (GHIO) algorithm retrieves the lost phase information from diffraction intensity with a much better accuracy. In addition we have developed a new method by using the moment of charge distribution to align the reconstructed two-dimensional images. These images were used to reconstruct a three-dimensional image by equally sloped tomography. Both theoretical models and experimental data of a GaN quantum dot particle [1] have been used to demonstrate the effectiveness of the method.

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[1] J. Maio, C. C. Chen, C. Song, Y. Nishino, Y. Kohmura, T. Ishikawa, D. Ramunno-Johnson, T. K. Lee and S. H. Risbud, “Three-Dimensional GaN-Ga2O3 Core Shell Structure Revealed by X-ray Diffraction Microscopy”, Phys. Rev. Lett. 97, 215503 (2006).